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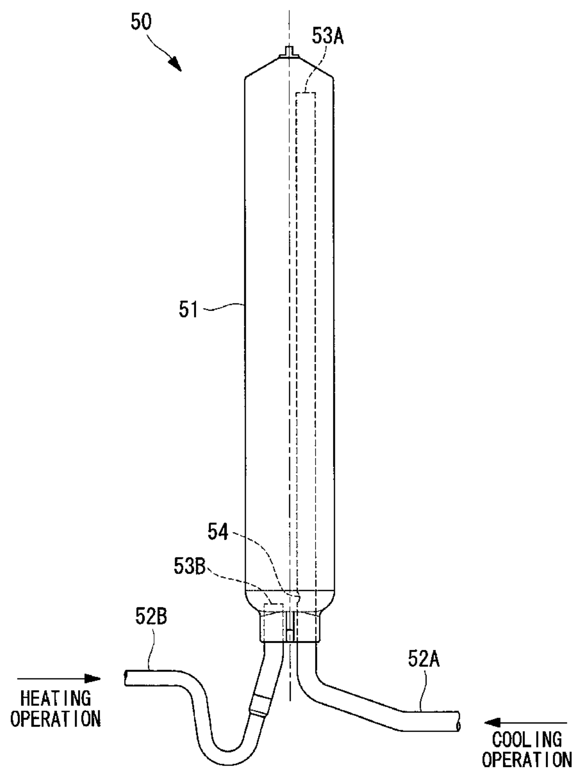
(54) **REVERSIBLE RECEIVER, AND AIR CONDITIONER**

(57) Provided are a reversible receiver that is used in a multi-type air conditioner and that can suppress an excessive increase in the pressure of a refrigerant during heating operation even if the number of indoor units is reduced, and an air conditioner. The reversible receiver includes a container (51) storing the refrigerant therein; a first pipe (52) having an opening (53A) at an upper end thereof and extending upward from a lower portion of the container (51), the first pipe (52A) allowing the refrigerant to flow into the container (51) when cooling operation is performed and allowing the refrigerant to flow out from the container (51) when heating operation is performed by the air conditioner; and a second pipe (52B) having an opening (53B) at an upper end thereof and extending upward from the lower portion of the container (51), the second pipe (52B) allowing the refrigerant to flow out from the container (51) when the cooling operation is performed and allowing the refrigerant to flow into the container (51) when the heating operation is performed by the air conditioner. The first pipe (52A) extends further upward relative to the second pipe (52B), and a side surface of an area, which is disposed within the container (51), of the first pipe (52A) is provided with a communicating hole (54) that connects the first pipe (52A) and an interior of the container (51).

FIG. 2

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## Description

{Technical Field}

**[0001]** The present invention relates to a reversible receiver suitable for use in an air conditioner that operates in a heat-pump refrigeration cycle in which the direction of flow of a refrigerant is switchable, and to an air conditioner.

{Background Art}

**[0002]** It is generally known that an optimal amount of refrigerant changes in an air conditioner that employs a heat-pump refrigeration cycle that switches between a cooling mode and a heating mode by switching the direction of flow of the refrigerant. For this reason, such an air conditioner is provided with a reversible receiver serving as a component for temporarily storing (holding) excess refrigerant so as to control the amount of refrigerant circulating through the air conditioner to an optimal level (for example, see Patent Literature 1}.

**[0003]** For example, in a multi-type air conditioner equipped with multiple indoor units for a single outdoor unit, excess refrigerant during cooling operation is temporarily stored (held) in the receiver, whereas excess refrigerant during heating operation is held in indoor heat exchangers by slightly opening electronic expansion valves for indoor units that are not used for the current heating operation, thereby controlling the amount of circulating refrigerant to an optimal level.

{Citation List}

{Patent Literature}

**[0004]**

{PTL 1}
Japanese Unexamined Patent Application, Publication No. Hei 10-170107

{Summary of Invention}

{Technical Problem}

**[0005]** However, if the number of indoor units in the multi-type air conditioner is reduced, there is a problem in that the pressure of the refrigerant in the indoor units performing the heating operation increases excessively.
Specifically, a reduced number of indoor units means a reduced number of indoor heat exchangers that can be used for holding the refrigerant during the heating operation. This possibly results in reduced controllability of the amount of refrigerant circulating during the heating operation. In other words, because the amount of refrigerant that can be held during the heating operation is reduced, there is a possibility that the refrigerant pressure in an area where the refrigerant increases in pressure during the heating operation, such as the indoor heat exchangers performing the heating operation, becomes excessively high.

**[0006]** The present invention has been made to solve the aforementioned problems, and an object thereof is to provide a reversible receiver that is used in a multi-type air conditioner and that can suppress an excessive increase in the pressure of a refrigerant during heating operation even if the number of indoor units is reduced, and an air conditioner.

{Solution to Problem}

**[0007]** In order to achieve the aforementioned object, the present invention provides the following solutions.
A reversible receiver according to an aspect of the present invention is used in a heat-pump air conditioner in which a direction of flow of a refrigerant is reversibly switchable, and includes a container that stores the refrigerant therein; a first pipe that has an opening at an upper end thereof and that extends upward from a lower portion of the container, the first pipe allowing the refrigerant to flow into the container when cooling operation is performed by the air conditioner and allowing the refrigerant to flow out from the container when heating operation is performed by the air conditioner; and a second pipe that has an opening at an upper end thereof and that extends upward from the lower portion of the container, the second pipe allowing the refrigerant to flow out from the container when the cooling operation is performed by the air conditioner and allowing the refrigerant to flow into the container when the heating operation is performed by the air conditioner. The first pipe extends further upward relative to the second pipe, and a side surface of an area, which is disposed within the container, of the first pipe is provided with a communicating hole that connects the first pipe and an interior of the container. The second pipe is connected to a throttle mechanism that decompresses the pressure of

the refrigerant in the air conditioner.

**[0008]** According to the above aspect, the reversible receiver can temporarily store a liquid refrigerant both during the heating operation and the cooling operation of an air conditioner in which the direction of flow of a refrigerant is switchable. Specifically, during the heating operation, the refrigerant containing a mixture of liquid refrigerant and gaseous refrigerant decompressed by the throttle mechanism flows into the reversible receiver via the second pipe. The gaseous refrigerant flows into the first pipe through the opening formed at the upper end of the pipe so as to flow out from the reversible receiver. Most of the liquid refrigerant is held within the container. A portion of the liquid refrigerant flows into the first pipe together with a lubricant (such as lubricating oil) contained in the liquid refrigerant through the communicating hole formed in the side surface of the pipe so as to flow out from the reversible receiver. Therefore, the liquid refrigerant can be held within the reversible receiver even during the heating operation of the air conditioner.

**[0009]** On the other hand, the direction of flow of the refrigerant during the cooling operation is opposite to that in the heating operation, such that the liquid refrigerant condensed by a heat exchanger flows into the reversible receiver via the first pipe. Although the liquid refrigerant flows into the throttle mechanism via the second pipe, because the flow rate of liquid refrigerant traveling through the throttle mechanism is limited, excess liquid refrigerant accumulates in the reversible receiver. Therefore, the liquid refrigerant can be temporarily stored in the reversible receiver during the cooling operation.

Unlike the reversible receiver discussed in the patent literature in the related art, a partition plate that divides an area where the first pipe is disposed from an area where the second pipe is disposed is not provided within the container, thereby reducing the flow resistance when the refrigerant travels through the reversible receiver.

**[0010]** In the above aspect, it is desirable that the opening in the second pipe and the communicating hole be disposed near a lower end of the container, and that the opening in the first pipe be disposed near an upper end of the container.

**[0011]** According to the above aspect, when the air conditioner performs the heating operation, the amount of liquid refrigerant that can be held within the reversible receiver can be increased, and the lubricant contained in the liquid refrigerant can be readily made to flow outward from the reversible receiver.

Specifically, since the opening in the first pipe is disposed near the upper end of the container, the liquid refrigerant starts to flow outward from the reversible receiver via the first pipe when the liquid level of the liquid refrigerant rises to the opening. In other words, the amount of liquid refrigerant held within the container is increased. Moreover, by disposing the communicating hole near the lower end of the container, the lubricant that tends to accumulate at the bottom of the container can readily flow into the first pipe via the communicating hole.

**[0012]** On the other hand, when the air conditioner performs the cooling operation, the liquid refrigerant can be readily supplied to the throttle mechanism.

Specifically, in the container, the liquid refrigerant tends to accumulate at the bottom, whereas the gaseous refrigerant tends to accumulate at the top. Because the opening of the second pipe that supplies the refrigerant to the throttle mechanism is disposed near the lower end of the container, the opening can be disposed inside the accumulated liquid refrigerant, whereby the liquid refrigerant can be readily supplied to the throttle mechanism.

**[0013]** An air conditioner according to an aspect of the present invention includes an outdoor unit having an outdoor heat exchanger, an indoor unit having an indoor heat exchanger, and the aforementioned reversible receiver according to the present invention. The first pipe is connected to the outdoor heat exchanger so as to allow the refrigerant to flow therebetween, and the second pipe is connected to the indoor heat exchanger via the throttle mechanism so as to allow the refrigerant to flow therebetween.

**[0014]** According to the above aspect, the liquid refrigerant can be held within the reversible receiver even during the heating operation of the air conditioner.

For example, in a multi-type air conditioner in which multiple indoor units are connected to a single outdoor unit, a minimum number of indoor units connected to the outdoor unit can be reduced. In other words, the installation versatility of a multi-type air conditioner can be increased.

{Advantageous Effects of Invention}

**[0015]** In the reversible receiver and the air conditioner according to the present invention, the first pipe extends further upward relative to the second pipe, the side surface of the first pipe is provided with the communicating hole, and the second pipe is connected to the throttle mechanism in the air conditioner, thereby advantageously suppressing an excessive increase in the pressure of the refrigerant during the heating operation even if the number of indoor units is reduced in a multi-type air conditioner.

{Brief Description of Drawings}

**[0016]**

{Fig. 1} Fig. 1 schematically illustrates the configuration of an air conditioner according to an embodiment of the present invention.
{Fig. 2} Fig. 2 is a front view illustrating the configuration of a receiver in Fig. 1.

{Description of Embodiments}

**[0017]** An air conditioner according to an embodiment of the present invention will now be described with reference to Figs. 1 and 2.
Fig. 1 schematically illustrates the configuration of the air conditioner according to this embodiment.
As shown in Fig. 1, an air conditioner 1 according to this embodiment is a so-called multi-type air conditioner that includes four indoor units 4A, 4B, 4C, and 4D for a single outdoor unit 2. The number of indoor units is not particularly limited so long as multiple indoor units are provided, and may be larger or smaller than four.
**[0018]** As shown in Fig. 1, the outdoor unit 2 is mainly provided with a compressor 21, a four-way valve 22, an outdoor heat exchanger 23, and expansion valves (i.e., throttle mechanisms) 24A, 24B, 24C, and 24D.
Liquid control valves 25A, 25B, 25C, and 25D and gas control valves 26A, 26B, 26C, and 26D are provided between the outdoor unit 2 and the indoor units 4A, 4B, 4C, and 4D.
**[0019]** The compressor 21 circulates a refrigerant between the single outdoor unit 2 and the four indoor units 4A, 4B, 4C, and 4D and takes in a low-temperature, low-pressure refrigerant and compresses it into a high-temperature, high-pressure refrigerant. The compressor 21 has an intake that is connected to an accumulator 27 and a separate accumulator 28 so as to allow the refrigerant to flow therefrom, and also has an outlet that is connected to a muffler 29 so as to allow the refrigerant to flow thereto.
The compressor 21 used is not particularly limited to a certain type and may be of a known type of compressor, such as a scroll-type compressor.
**[0020]** The accumulator 27 and the separate accumulator 28 supply a gaseous refrigerant to the compressor 21 and temporarily store a liquid refrigerant so as to control the flow of refrigerant between the single outdoor unit 2 and the four indoor units 4A, 4B, 4C, and 4D.
The accumulator 27 is disposed between the compressor 21 and the separate accumulator 28 and is connected to the intake of the compressor 21 so as to be able to supply the gaseous refrigerant thereto. The separate accumulator 28 is disposed between the accumulator 27 and the four-way valve 22 and is connected to the accumulator 27 so as to be able to supply the gaseous refrigerant thereto.
An intake pipe sensor 31 that measures the temperature of the refrigerant to be taken into the compressor 21 is disposed in a pipe that connects the accumulator 27 and the separate accumulator 28.
**[0021]** The muffler 29 alleviates pressure fluctuations in the refrigerant discharged from the compressor 21 so as to reduce the occurrence of vibration and noise caused by such pressure fluctuations.
The muffler 29 is disposed between the compressor 21 and the four-way valve 22 and is connected to the outlet of the compressor 21 so as to allow the refrigerant to flow therefrom. A discharge pipe sensor 32 that measures the temperature of the refrigerant discharged from the compressor 21 is disposed in a pipe that connects the muffler 29 and the compressor 21.
**[0022]** The four-way valve 22 controls the output destination for the refrigerant discharged from the compressor 21 in accordance with the operation mode of the air conditioner 1.
Specifically, during cooling operation, the four-way valve 22 guides the refrigerant discharged from the compressor 21 toward the outdoor heat exchanger 23 and guides the refrigerant flowing out from indoor heat exchangers 41 toward the compressor 21. During heating operation, the four-way valve 22 guides the refrigerant discharged from the compressor 21 toward the indoor heat exchangers 41 and guides the refrigerant flowing out from the outdoor heat exchanger 23 toward the compressor 21.
**[0023]** The four-way valve 22 is connected such that the refrigerant can flow out therefrom toward the separate accumulator 28 and can also flow into the four-way valve 22 from the muffler 29. Moreover, the four-way valve 22 is connected such that the refrigerant can flow into or out from the four-way valve 22 from or toward the outdoor heat exchanger 23 and the indoor heat exchangers 41 of the indoor units 4A, 4B, 4C, and 4D.
The four-way valve 22 used is not particularly limited to a certain type and may be of a known type of valve.
**[0024]** The outdoor heat exchanger 23 performs heat exchange between outside air and the refrigerant. Specifically, the outdoor heat exchanger 23 causes the refrigerant to dissipate heat to the outside air during the cooling operation and causes the refrigerant to absorb heat from the outside air during the heating operation. The outdoor heat exchanger 23 is disposed between the four-way valve 22 and a receiver (i.e., a reversible receiver) 50 and is connected therebetween so as to allow the refrigerant to flow therebetween.
An outdoor heat exchanger sensor 34 that measures the temperature of the outdoor heat exchanger 23 and an outside air temperature sensor 35 that measures the temperature of the outside air are disposed in the outdoor heat exchanger 23.
**[0025]** Fig. 2 is a front view illustrating the configuration of the receiver in Fig. 1.

The receiver 50 is disposed between the outdoor heat exchanger 23 and the expansion valves 24A, 24B, 24C, and 24D and is connected therebetween so as to allow the refrigerant to flow therebetween. The receiver 50 supplies the liquid refrigerant to the expansion valves 24A, 24B, 24C, and 24D during the cooling operation and stores (holds) excess liquid refrigerant during the heating operation.
As shown in Fig. 2, the receiver 50 is provided with a container 51, a first pipe 52A, and a second pipe 52B.

**[0026]** The container 51 stores the liquid refrigerant and the gaseous refrigerant therein. In this embodiment, the container 51 used has, for example, a cylindrical shape both ends of which are closed.

**[0027]** As shown in Figs. 1 and 2, the first pipe 52A connects the container 51 and the outdoor heat exchanger 23 so as to allow the refrigerant to flow therebetween.
As shown in Fig. 2, the first pipe 52A extends into the container 51 from the lower end of the container 51. The first pipe 52A is disposed so as to extend toward the upper end of the container 51 through the interior of the container 51, and an opening 53A of the first pipe 52A that is connected to the interior of the container 51 is disposed near the upper end of the container 51.

**[0028]** A side surface of the first pipe 52A is provided with a communicating hole 54 that connects the interior of the first pipe 52A to the interior of the container 51. The communicating hole 54 allows lubricating oil (lubricant), stored inside the container 51, for the compressor 21 to flow into the first pipe 52A. The communicating hole 54 is formed in a lower region of the first pipe 52A disposed inside the container 51, that is, at a position near the lower end of the container 51. In this embodiment, the communicating hole 54 is formed near an opening 53B of the second pipe 52B.

**[0029]** The diameter of the communicating hole 54 is set on the basis of a target value for the amount of liquid refrigerant to be held inside the container 51 during the heating operation. Specifically, the diameter is set on the basis of the flow rate of liquid refrigerant flowing into the container 51 during the heating operation and the flow rate of liquid refrigerant flowing into the communicating hole 54.

**[0030]** As shown in Figs. 1 and 2, the second pipe 52B connects the container 51 and the expansion valves 24A, 24B, 24C, and 24D so as to allow the refrigerant to flow therebetween. In other words, the second pipe 52B connects the container 51 and the indoor heat exchangers 41 so as to allow the refrigerant to flow therebetween.
As shown in Fig. 2, the second pipe 52B extends into the container 51 from the lower end of the container 51. The opening 53B of the second pipe 52B that is connected to the interior of the container 51 is disposed near the lower end of the container 51.

**[0031]** The expansion valves 24A, 24B, 24C, and 24D adiabatically expand the refrigerant flowing therethrough so as to reduce the temperature and the pressure of the refrigerant. The expansion valves 24A, 24B, 24C, and 24D are disposed in correspondence with the indoor units 4A, 4B, 4C, and 4D, respectively. In other words, the expansion valves 24A, 24B, 24C, and 24D are connected to the respective indoor units 4A, 4B, 4C, and 4D so as to allow the refrigerant to flow therebetween. Specifically, the expansion valves 24A, 24B, 24C, and 24D are respectively disposed in four pipes that branch off from a single pipe extending from the receiver 50 so as to correspond to the indoor units 4A, 4B, 4C, and 4D.

**[0032]** The liquid control valves 25A, 25B, 25C, and 25D are connected to pipes extending from the indoor units 4A, 4B, 4C, and 4D and are disposed in correspondence with the indoor units 4A, 4B, 4C, and 4D, respectively. The liquid control valves 25A, 25B, 25C, and 25D are disposed in correspondence with the expansion valves 24A, 24B, 24C, and 24D, and silencer capillary tubes 36 and strainers 37 are disposed therebetween.

**[0033]** The gas control valves 26A, 26B, 26C, and 26D are connected to pipes extending from the indoor units 4A, 4B, 4C, and 4D and are disposed in correspondence with the indoor units 4A, 4B, 4C, and 4D, respectively. The gas control valves 26A, 26B, 26C, and 26D are connected to the four-way valve 22 via a manifold 38 so as to allow the refrigerant to flow therebetween.

**[0034]** As shown in Fig. 1, the indoor units 4A, 4B, 4C, and 4D are mainly provided with the indoor heat exchangers 41, intake sensors 42, intermediate heat exchanger sensors 43, and cooling outlet heat exchanger sensors 44.

**[0035]** The indoor heat exchangers 41 are disposed in the respective indoor units 4A, 4B, 4C, and 4D and perform heat exchange between indoor air and the refrigerant. Specifically, the indoor heat exchangers 41 cause the refrigerant to absorb heat from the indoor air during the cooling operation and cause the refrigerant to dissipate heat to the indoor air during the heating operation.
The indoor heat exchangers 41 of the indoor units 4A, 4B, 4C, and 4D are connected to the liquid control valves 25A, 25B, 25C, and 25D and the gas control valves 26A, 26B, 26C, and 26D, respectively, so as to allow the refrigerant to flow therebetween.

**[0036]** The intake sensors 42 that measure the temperature of indoor air taken into the indoor units 4A, 4B, 4C, and 4D, the intermediate heat exchanger sensors 43 that measure the temperature at intermediate sections of the indoor heat exchangers 41, and the cooling outlet heat exchanger sensors 44 that measure the temperature at ends, which serve as outlets for the refrigerant during the cooling operation, of the indoor heat exchangers 41 are disposed in the respective indoor heat exchangers 41.

**[0037]** Next, the cooling operation and the heating operation performed in the air conditioner 1 having the above-described configuration will be described.

**[0038]** As shown in Fig. 1, when the cooling operation is to be performed, the four-way valve 22 is switched so that the outlet of the compressor 21 is connected to the outdoor heat exchanger 23, and the intake of the compressor 21 is connected to the indoor heat exchangers 41.
The high-temperature, high-pressure refrigerant discharged from the compressor 21 flows into the outdoor heat exchanger 23 via the muffler 29 and the four-way valve 22. The refrigerant dissipates heat to the outside air at the outdoor heat exchanger 23 so as to condense into a liquid refrigerant. The high-pressure liquid refrigerant is guided from the outdoor heat exchanger 23 to the expansion valves 24A, 24B, 24C, and 24D via the receiver 50.
**[0039]** The high-pressure liquid refrigerant adiabatically expands into a low-temperature, low-pressure refrigerant as it travels through the expansion valves 24A, 24B, 24C, and 24D. The low-temperature, low-pressure refrigerant flows into the indoor heat exchangers 41 of the indoor units 4A, 4B, 4C, and 4D via the silencer capillary tubes 36, the strainers 37, and the liquid control valves 25A, 25B, 25C, and 25D. The refrigerant absorbs heat from the indoor air at the indoor heat exchangers 41 so as to vaporize into a gaseous refrigerant. On the other hand, the indoor air surrendering the heat is cooled.
**[0040]** The gaseous refrigerant is taken into the intake of the compressor 21 via the gas control valves 26A, 26B, 26C, and 26D, the manifold 38, the four-way valve 22, the separate accumulator 28, and the accumulator 27. The refrigerant taken in is compressed by the compressor 21 and is discharged from the outlet as a high-temperature, high-pressure refrigerant. Subsequently, the cooling operation is continuously performed by repeating the above-described process.
**[0041]** As shown in Fig. 1, when the heating operation is to be performed, the four-way valve 22 is switched so that the outlet of the compressor 21 is connected to the indoor heat exchangers 41, and the intake of the compressor 21 is connected to the outdoor heat exchanger 23.
The high-temperature, high-pressure refrigerant discharged from the compressor 21 flows into the indoor heat exchangers 41 via the muffler 29 and the four-way valve 22. The refrigerant dissipates heat to the indoor air at the indoor heat exchangers 41 so as to condense into a liquid refrigerant. On the other hand, the indoor air absorbing the heat is heated.
The high-pressure liquid refrigerant is guided from the indoor heat exchangers 41 to the expansion valves 24A, 24B, 24C, and 24D via the liquid control valves 25A, 25B, 25C, and 25D, the strainers 37, and the silencer capillary tubes 36.
**[0042]** The high-pressure liquid refrigerant adiabatically expands into a low-temperature, low-pressure refrigerant as it travels through the expansion valves 24A, 24B, 24C, and 24D. The low-temperature, low-pressure refrigerant flows into the outdoor heat exchanger 23 via the receiver 50. The refrigerant absorbs heat from the outside air at the outdoor heat exchanger 23 so as to vaporize into a gaseous refrigerant.
**[0043]** The gaseous refrigerant is taken into the intake of the compressor 21 via the four-way valve 22, the separate accumulator 28, and the accumulator 27. The refrigerant taken in is compressed by the compressor 21 and is discharged from the outlet as a high-temperature, high-pressure refrigerant. Subsequently, the heating operation is continuously performed by repeating the above-described process.
**[0044]** Next, the flow and storage of the refrigerant in the receiver 50, which is a characteristic feature of this embodiment, will be described.
First, the following description relates to how the liquid refrigerant is stored in the receiver 50 during the heating operation, that is, how the liquid refrigerant is held by the receiver 50.
**[0045]** When the air conditioner 1 performs the heating operation, the refrigerant including a mixture of liquid refrigerant and gaseous refrigerant decompressed by the expansion valves 24A, 24B, 24C, and 24D flows into the receiver 50 via the second pipe 52B. The gaseous refrigerant flows into the first pipe 52A through the opening 53A formed at the upper end of the pipe so as to flow out from the receiver 50. Therefore, most of the liquid refrigerant is held within the container.
A portion of the liquid refrigerant flows into the first pipe 52A together with the lubricating oil contained in the liquid refrigerant through the communicating hole 54 formed in the side surface of the pipe so as to flow out from the receiver 50.
Since the flow rate of liquid refrigerant flowing out from the container 51 via the communicating hole 54 is lower than the flow rate of liquid refrigerant flowing into the container 51 from the second pipe 52B, the liquid refrigerant is held in the receiver 50 even when the air conditioner 1 is performing the heating operation.
**[0046]** Since the opening 53A in the first pipe 52A is disposed near the upper end of the container 51, the liquid refrigerant starts to flow outward from the receiver 50 via the first pipe 52A when the liquid level of the liquid refrigerant rises to the opening 53A. In other words, the amount of liquid refrigerant held within the container 51 is increased. Moreover, since the communicating hole 54 is disposed near the lower end of the container 51, the lubricating oil that tends to accumulate at the bottom of the container 51 can readily flow into the first pipe via the communicating hole 54.
**[0047]** When the air conditioner 1 performs the cooling operation, the direction of flow of the refrigerant is opposite to that in the heating operation, such that the liquid refrigerant condensed by the outdoor heat exchanger 23 flows into the receiver 50 via the first pipe 52A. Although the liquid refrigerant flows into the expansion valves 24A, 24B, 24C, and 24D via the second pipe 52B, because the flow rate of liquid refrigerant traveling through the expansion valves 24A, 24B, 24C, and 24D is limited, excess liquid refrigerant accumulates in the receiver 50. Therefore, the liquid refrigerant is temporarily stored in the receiver 50 during the cooling operation.
Unlike the reversible receiver discussed in the patent literature in the related art, a partition plate that divides an area

where the first pipe 52A is disposed from an area where the second pipe 52B is disposed is not provided within the container, thereby reducing the flow resistance when the refrigerant travels through the receiver 50.

**[0048]** In the container 51, the liquid refrigerant tends to accumulate at the bottom, whereas the gaseous refrigerant tends to accumulate at the top. Because the opening 53B of the second pipe 52B that supplies the refrigerant to the expansion valves 24A, 24B, 24C, and 24D is disposed near the lower end of the container 51, the opening 53B can be disposed inside the accumulated liquid refrigerant, whereby the liquid refrigerant can be readily supplied to the expansion valves 24A, 24B, 24C, and 24D.

**[0049]** With the above-described configuration, the liquid refrigerant can be held within the receiver 50 even during the heating operation so that an excessive increase in the pressure of the refrigerant in the indoor heat exchangers 41 and the like can be prevented even if the number of indoor units 4A, 4B, 4C, and 4D connected to the outdoor unit 2 were to be reduced. In other words, a minimum number of connected indoor units 4A, 4B, 4C, and 4D can be reduced in the air conditioner 1 so as to allow for increased installation versatility of the air conditioner 1, thereby achieving an air conditioner 1 that meets a wider range of market needs.

{Reference Signs List}

**[0050]**

| | |
|---|---|
| 1 | air conditioner |
| 2 | outdoor unit |
| 4A, 4B, 4C, 4D | indoor unit |
| 23 | outdoor heat exchanger |
| 24A, 24B, 24C, 24D | expansion valve (throttle mechanism) |
| 41 | indoor heat exchanger |
| 50 | receiver (reversible receiver) |
| 51 | container |
| 52A | first pipe |
| 52B | second pipe |
| 53A | opening |
| 53B | opening |
| 54 | communicating hole |

**Claims**

**1.** A reversible receiver used in a heat-pump air conditioner in which a direction of flow of a refrigerant is reversibly switchable, comprising:

a container that stores the refrigerant therein;
a first pipe that has an opening at an upper end thereof and that extends upward from a lower portion of the container, wherein the first pipe allows the refrigerant to flow into the container when cooling operation is performed by the air conditioner, and allows the refrigerant to flow out from the container when heating operation is performed by the air conditioner; and
a second pipe that has an opening at an upper end thereof and that extends upward from the lower portion of the container, wherein the second pipe allows the refrigerant to flow out from the container when the cooling operation is performed by the air conditioner, and allows the refrigerant to flow into the container when the

heating operation is performed by the air conditioner,
wherein the first pipe extends further upward relative to the second pipe, and a side surface of an area, which is disposed within the container, of the first pipe is provided with a communicating hole that connects the first pipe and an interior of the container, and
wherein the second pipe is connected to a throttle mechanism that decompresses the pressure of the refrigerant in the air conditioner.

**2.** The reversible receiver according to Claim 1, wherein the opening in the second pipe and the communicating hole are disposed near a lower end of the container, and
wherein the opening in the first pipe is disposed near an upper end of the container.

**3.** An air conditioner comprising:

an outdoor unit having an outdoor heat exchanger;
an indoor unit having an indoor heat exchanger; and
the reversible receiver according to Claim 1 or 2,
wherein the first pipe is connected to the outdoor heat exchanger so as to allow the refrigerant to flow therebetween, and
wherein the second pipe is connected to the indoor heat exchanger via the throttle mechanism so as to allow the refrigerant to flow therebetween.

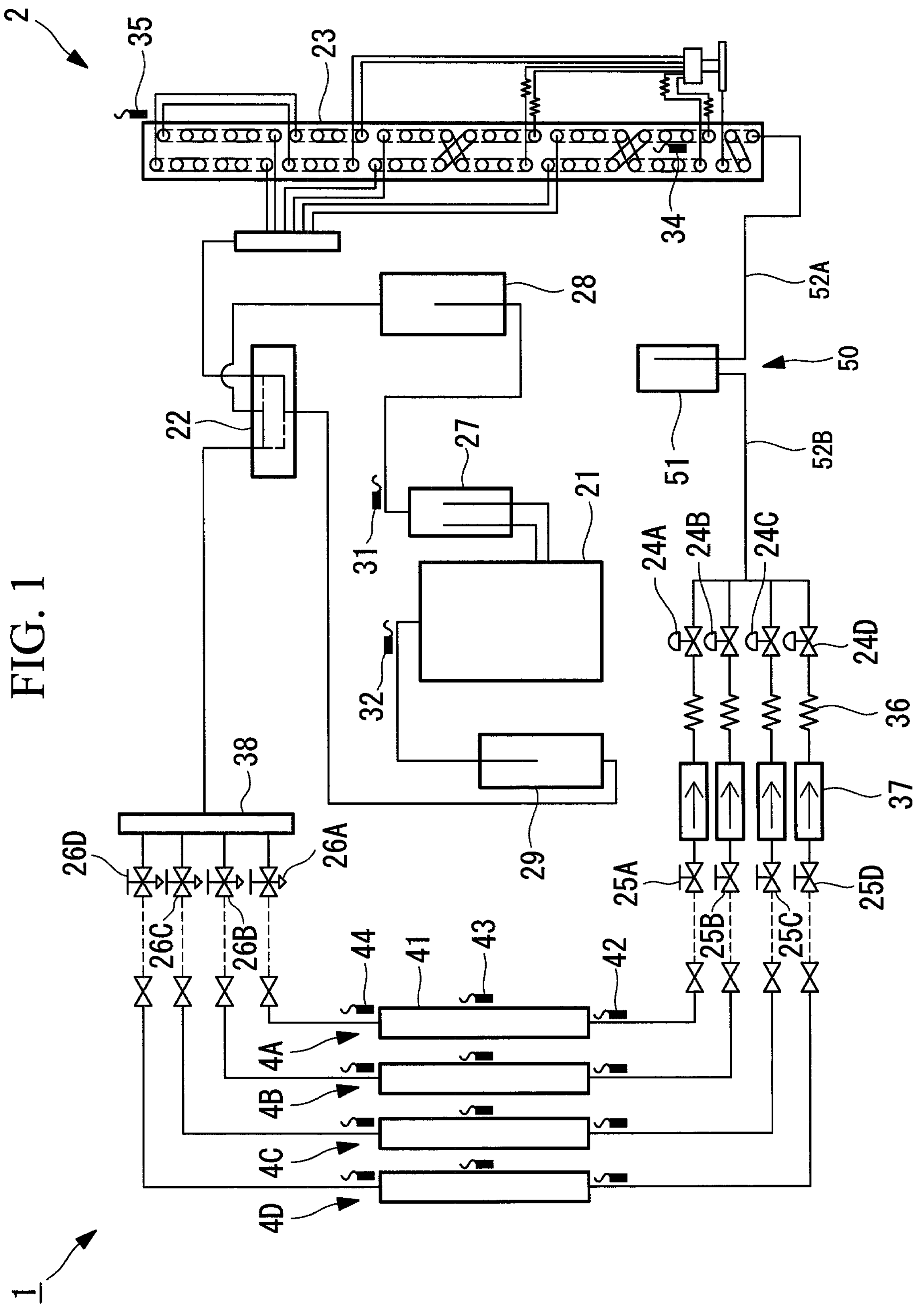
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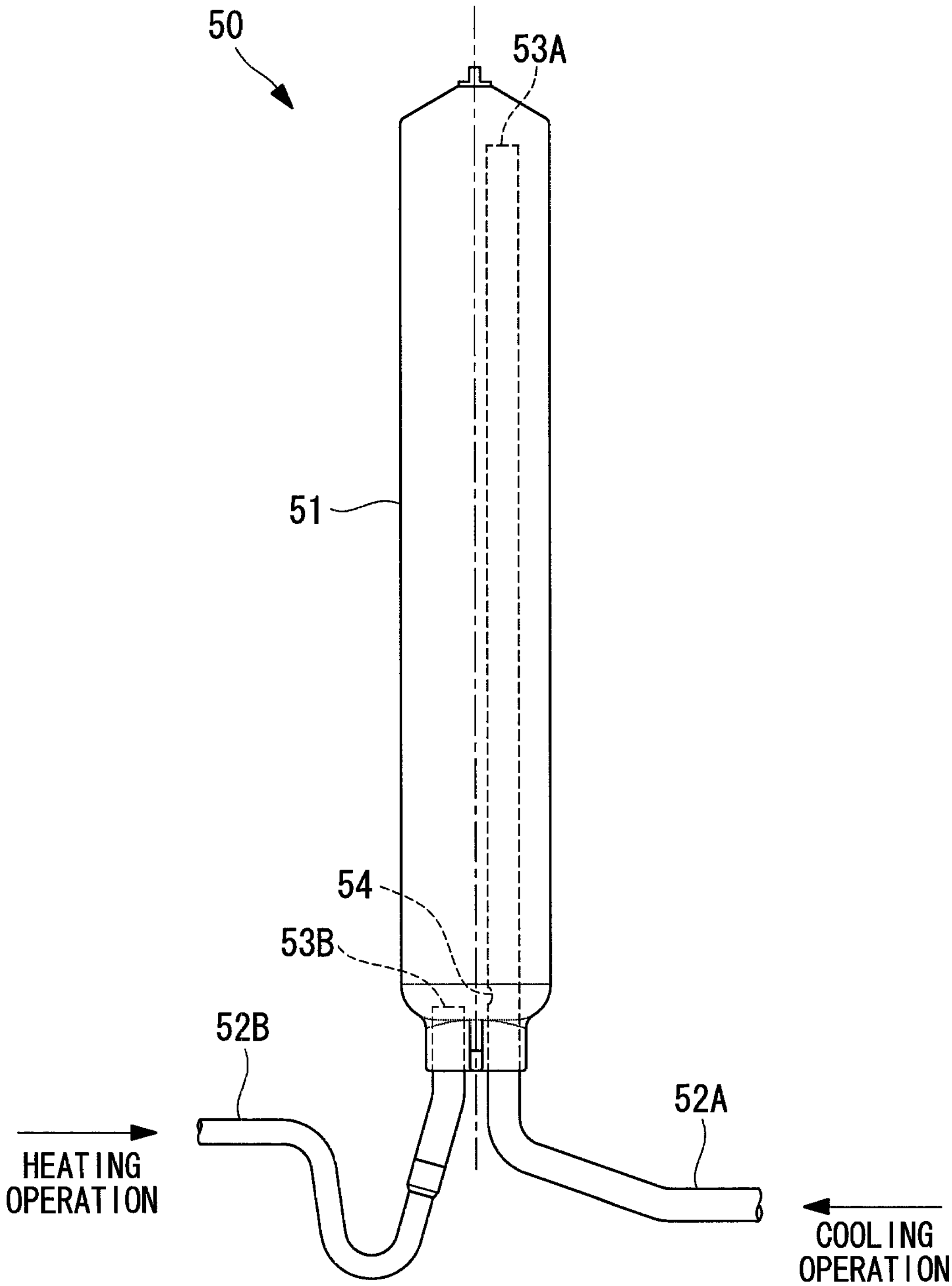
FIG. 1

# FIG. 2


50
53A
51
54
53B
52B
52A
HEATING
OPERATION
COOLING
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## INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/050636

A. CLASSIFICATION OF SUBJECT MATTER
*F25B1/00*(2006.01)i, *F25B13/00*(2006.01)i, *F25B43/00*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F25B1/00, F25B13/00, F25B43/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

| | | | |
|---|---|---|---|
| Jitsuyo Shinan Koho | 1922-1996 | Jitsuyo Shinan Toroku Koho | 1996-2011 |
| Kokai Jitsuyo Shinan Koho | 1971-2011 | Toroku Jitsuyo Shinan Koho | 1994-2011 |

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | JP 11-248267 A (Mitsubishi Electric Corp.), 14 September 1999 (14.09.1999), paragraphs [0060] to [0064]; fig. 10 to 11 (Family: none) | 1-3 |
| X | JP 7-139833 A (Daikin Industries, Ltd.), 02 June 1995 (02.06.1995), paragraphs [0013] to [0014]; fig. 1 to 3 & US 5533351 A & EP 622594 A1 & WO 1994/012834 A1 & DE 69317761 C & ES 2114163 T & CN 1096577 A | 1-3 |

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 05 April, 2011 (05.04.11) | 12 April, 2011 (12.04.11) |

| Name and mailing address of the ISA/ | Authorized officer |
|---|---|
| Japanese Patent Office | |
| Facsimile No. | Telephone No. |

Form PCT/ISA/210 (second sheet) (July 2009)

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


- JP HEI10170107 B **[0004]**